

**GLADSTONE AREA
WATER BOARD**

Drought Management Plan

Revised November 2015

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DEFINITIONS

'AWSIM-D' means the GAWB designed Awoonga Dam Simulation Drought Model.

'AHD' means Australian Height Datum as determined by Australian Survey and Land Information Group, Commonwealth of Australia, 2000.

'Augmentation Trigger' is the time at which construction is scheduled to commence on the augmentation.

'Base Case' demand forecast has the meaning set out in Chapter 5 of this DMP.

'Boyne ROP' means the *Boyne River Resource Operations Plan 2013* (previously 2003).

'Connections' has the meaning given to it by the Water Services Association of Australia.

'Curtailment Agreement' means an agreement made between GAWB and the Customer (normally as part of a Customer's contract) and prior to any Drought Period, to reduce the Customer's Water Reservation to a pre-determined level (over and above Restrictions) upon future milestones being reached. This is separate to a Demand Reduction Strategy which may be presented by a Customer following a Low Supply Alert.

'Customer' means a person to whom GAWB supplies water or has a contract for a supply of water. It includes prospective customers who, in accordance with GAWB's *Forward Water Sales Policy*, have water demand included in GAWB's Base Case demand forecast but excludes irrigation users downstream of Awoonga Dam.

'Dead Storage' is the volume of water remaining in Lake Awoonga below the level of the lowest off take and which cannot be used without the use of pumps or other means to extract it from the Lake.

'Demand Reduction Strategy' means a proposal (which may result in a binding agreement between a Customer and GAWB) for a Customer to restrict their use to a specified volume, which would be less than that volume available to the Customer following the imposition of a Supply Restriction.

'DEWS' means Department of Energy and Water Supply (the regulator), relevant sections previously within Department of Environment and Resource Management and or Department of Natural Resources.

'DMP' means Drought Management Plan.

'Drought Period' is the period of time starting with the announcement of a Supply Restriction and continuing for so long as Restrictions or the Low Supply Alert apply.

'DSITI' means Department of Science, Information Technology, Innovation relevant sections previously within Department of Environment and Resource Management and/or Department of Natural Resources

'Emergency Restriction' has the meaning set out in Chapter 5 of this DMP.

'End of the Wet Season' means 30 April each year.

'Forecast Demand' is the Base Case demand as set out in Chapter 5 of this DMP.

'GAWB' means the Gladstone Area Water Board.

'IQQM' means Integrated Quantity and Quality Model.

'ML' means mega-litre of water.

'Mlpa' means mega-litre per annum.

'Model' means the model developed by GAWB to determine Trigger Levels.

'Local Authority' means a local government supplied by GAWB, currently the Gladstone Regional Council.

'Low Supply Alert' means an alert of that name declared by GAWB in accordance with the DMP.

'Notice' means written notice.

'QCA' means Queensland Competition Authority.

'Restrictions' mean a reduction to a Customer's Water Reservation, expressed as a percentage reduction to a Water Reservation or a total prohibition on water use. This includes a Supply Restriction and Emergency Restriction.

'Supply Restriction' has the meaning set out in Chapter 5 of this DMP.

'Trigger Levels' are expressed in terms of Time Frame from Failure, storage elevation and volume (corresponding to the assumed inflows and demand forecast) and are milestones for Restrictions and augmentation.

'Time Frame from Failure' means the period that Forecast Demand can be maintained until Dead Storage is reached as calculated by the Model.

'Water Reservation' for any Customer means the volume of water which is reserved under contract to meet the lawful demands for water by that Customer over a future period (including the year in which Restrictions are applied).

'WSSRA' means the *Water Supply (Safety and Reliability) Act 2008*.

1 BACKGROUND

1.1 GLADSTONE AREA WATER BOARD

Gladstone Area Water Board (GAWB) is a Category 1 water authority established in accordance with the *Water Act 2000* and created as a body corporate pursuant to that Act. GAWB provides a bulk water service to the areas to which its infrastructure is able to transport water within the Gladstone region.

GAWB is also a registered water service provider under the WSSRA.

1.2 DROUGHT MANAGEMENT PLAN

GAWB's original DMP was registered by the regulator (now DEWS) on 12 September, 2007. The DMP was last revised 30 September, 2009.

Prior to 2014, the WSSRA set out the requirements for preparing a DMP. Previous revisions of the DMP were drafted to meet these requirements.

Amendments to the WSSRA gazetted in 2014 removed sections pertaining to the regulation of DMPs.

Since 2009 the DMP has been incorporated into GAWB's Management System and is referenced by contracts between GAWB and its customers. Therefore the need for a DMP remains.

GAWB undertakes a process of continual review and refinement of this plan in response to changes in information such as inflows, customer demands and available demand-side and supply-side options. This process includes consultation with customers about their needs and preferences.

2 DMP CONSIDERATIONS

The following considerations have been made in preparing this DMP.

- Public health

GAWB has considered the needs of Local Authorities and in particular the public health requirements for water for residential purposes. Should emergency conditions arise, despite the measures taken to avoid this (including source augmentation), then this DMP gives preference to Local Authorities to minimise impacts on communities by meeting basic public health requirements for residential water supply, in accordance with the WSSRA.

- Economic impact of restrictions

GAWB has also considered the needs of industrial customers in preparing this plan, as well as the potential scope for some industrial users to implement demand reduction strategies. GAWB accepts Customers' past representations that they have limited capacity to significantly abate demand without significant economic impacts.

- Contractual rights and application of DMP

This DMP is consistent with GAWB's standard form contracts being offered to customers.

This DMP applies Restrictions uniformly across the customer base (except in the case of emergency restrictions as noted above). This is consistent with GAWB's cost-

reflecting pricing structure which involves a uniform water reservation and storage price.

- Commercial flexibility

GAWB also accepts that some customers may have a further capacity to abate consumption or may be agreeable to further reduce demand subject to suitable commercial arrangements. GAWB's commercial and regulatory framework, executed through standard form customer contracts, provides for these arrangements to occur in order to defer Restrictions and/or augmentation, generating benefits for the broader customer base. This would include, for example, trading of Water Reservations between customers and Curtailment Agreements.

- Future requirements

This DMP provides for future requirements by incorporating a 10-year projection of water demands when triggering a Low Supply Alert, and allowing for Customers to adjust their water use prior to the application of Restrictions.

- Availability and proposed use of water from various sources

This DMP is based on GAWB's water allocation from Awoonga Dam as the current source of supply. Under the Boyne ROP, GAWB may draw 78,000ML per annum from Awoonga Dam

A second source is required to augment supply under extended drought conditions (or in the event of increasing demand in excess of the sustainable supply from Awoonga.). GAWB has undertaken extensive planning for a contingent supply source. For the reasons set out in GAWB's Strategic Water Plan 2013, a 30,000MLpa pipeline from the lower Fitzroy River is currently the preferred augmentation in all scenarios. GAWB is satisfied that, if required, water will be available from the lower Fitzroy River for this purpose.

- Consistency with the Boyne River Resource Operating Plan

The Water Sharing Rules in the ROP allows GAWB to carryover a limited amount unused water allocation from one water year to the next water year. The modelling used to set trigger levels assumes that GAWB draws from Awoonga 100% of GAWB Customer contracted future demand (base case projection) plus an allowance for losses. This base case plus losses total is currently less total allocation, and is forecast to remain so for the life of the current Plan. As implementation of the Drought Management Plan restricts supply from GAWB to customers to their contracted demand (or less) then there is no need for "carryover water" during the life of the Plan.

Releases for downstream water users are also specified in the Boyne ROP, for when water levels are between RL27m and RL 30m. These releases for downstream water users are not included in the modelling used to determine trigger levels as

- The releases are only triggered by a combination of minimum inflows into Awoonga and low water levels downstream of the Dam measured at Pikes Crossing. The latter criteria is strongly influenced by local inflows below Awoonga and downstream water usage for irrigation (neither of which is considered in the existing model);

- The total release for downstream water users is capped at 800 ML per water year, which is less than 1.3% of total GAWB contracted demand and thus of limited significance.

When the Dam level is above RL30m, then releases for downstream water users are adequately satisfied by the environmental release rules which operate when water levels are at or above that level. Environmental release rules are included in the modelling used to determine trigger levels.

3 SERVICE AND SYSTEM OVERVIEW

3.1 REGISTERED SERVICES

GAWB is a registered water service provider of bulk water services. The DMP relates to this service.

GAWB is the major bulk water provider for the Gladstone region, and is currently contracted to supply approximately 63,000Mlpa to its Customers. These Customers comprise the following:

- Bulk treated water supply to the Gladstone Regional Council, which in turn supplies this water to Gladstone City and the towns of Calliope, Tannum Sands, Boyne Island, Benaraby and Mt. Larcom and comprises approximately 20% of total demand. The Gladstone Regional Council's customers also include (treated water supply to) industries including Gladstone Power Station, Queensland Alumina Limited, and R G Tanna and Barney Point Coal Terminals. The Gladstone Regional Council is responsible for determining drought management practices concerning its customers, but is itself subject to GAWB's actions pursuant to this DMP;
- Bulk raw water and/or treated water supply to major industrial facilities located within Gladstone, the Gladstone State Development Area (to the North of Gladstone), Curtis Island, and Boyne Island, which draw water from GAWB's distribution network and account for approximately 40% of total contracted demand; and
- Callide B and Callide C power stations, which draw water directly from Lake Awoonga and account for approximately 40% of total contracted demand. Banana Shire Council has been granted an option to buy water drawn directly from Lake Awoonga. Although that option is not included in current demand, if Banana Shire exercised the option within the required time following a Low Supply Alert, that additional demand would be the subject of 50% Restrictions under any future Emergency Restrictions regime.

3.2 NATURE OF THE BULK WATER SERVICES

Raw / Untreated water

Approximately 80% of water supplied by GAWB is untreated water, supplied to industrial users and to an off-take pipeline for on-supply to Callide B and Callide C power stations.

Treated water

Potable water comprises approximately 20% of the total supply. Water supplied to the Local Authority for on-supply via their reticulation systems is principally for domestic use. GAWB understands that 50% of this water supply is for potable use.

Current and projected demand

GAWB undertakes regular demand forecasting as part of its planning process. The demand forecasts used for this DMP are based on contracted demand (Base Case demand).

3.3 INFRASTRUCTURE DETAILS

Awoonga Dam is the only current source of water for GAWB's customers.

The other major infrastructure facilities involved in supplying water to customers are:

- Raw water supply system comprising pump systems, reservoirs and pipeline network;
- Gladstone Water Treatment Plant and Yarwun Water Treatment Plants;
- Treated water delivery systems comprising pump systems, reservoirs and pipe network; and
- Support services based at Awoonga and Boyne Valley, and Gladstone Water Treatment Plant and 147 Goondoon Street, Gladstone

Appendix B provides a map of this infrastructure.

4 ASSESSMENT OF AVAILABLE WATER SOURCES

4.1 CURRENT WATER SOURCE

4.1.1 GAWB's water allocation from Awoonga Dam

Under the Boyne ROP, GAWB has an allocation of 78,000ML based on Awoonga Dam's current full supply level of 40 metres AHD. The Boyne River Basin Water Resource Plan sets a security objective for GAWB's water allocations at 100% monthly reliability using simulated historical stream flows.

The security objective in the Water Resource Plan is not a prediction of the future. There remains a possibility of failure due to future inflows being materially different to the historic flow sequence.

4.1.2 Historic rainfall and inflows

Records show there have been "short-term" droughts with very limited rainfall over periods of up to 12 months and typically with several months of zero or very low flows in the Boyne River. The worst short-term droughts were in 1941 and 1969. These droughts are often bracketed by periods of higher rainfall and inflow and therefore do not pose a risk of supply failure due to the large storage capacity of Awoonga Dam.

There have also been "long-term" droughts with a series of more than two weak wet seasons and subsequently low annual flows in the Boyne River, sometimes (but not always) coinciding with short-term droughts. The long-term droughts on record occurred during 1964–67, 1993–95, 1997–2003 and 2004–2008. These droughts (particularly those in the period 1997 – 2007) place limits on the available reliable supply capacity of Awoonga Dam.

4.1.3 Impacts from climate change

Historic inflow information is an imperfect guide to future inflow conditions given the limited length of record, measurement issues and the large variance in inflows between years. This need for caution is further highlighted by the prospects of climate change and the effect on the pattern and amount of rainfall, evaporation and inflows.

Work commissioned by GAWB suggests that:

- There is an inter-decadal fluctuation in climate affect on rainfall on the Central Queensland coast, which may not be captured in any stochastic analysis of inflow data resulting in an under-estimate of the probability of future drought conditions; and
- Modelling studies in general tend to point to drier rather than wetter conditions in the future, in particular increase temperatures increasing evaporation and thereby inducing drier catchment conditions with decreasing runoff.

4.2 FREQUENCY OF DROUGHT PERIODS

The frequency and extent of a Drought Period is difficult to assess, given the uncertainty over future inflows and storage performance. Historic data indicates that:

1. Between 25 and 30 % of years (water year = financial year: July to June) have inflows of less than the historic no failure yield of Awoonga Dam.
2. Weak positive serial correlation between annual inflows of succeeding years – i.e. that year with higher or lower than average inflow will be followed by another year of similar inflow. This is thought to be the combined effect of catchment moisture conditions and of larger climate/ weather cycles (e.g. ENSO) affecting rainfall.

GAWB's focus is to prepare for such events to ensure timely and considered response and to adapt to circumstances as they arise – including prolonged years of unprecedented drought conditions.

4.3 HYDROLOGIC MODELLING

Inflows into the Awoonga storage cannot (reliably) be measured directly and have been estimated using the Boyne River Catchment IQQM Model developed by DSITI for the Boyne River Water Resource Plan and Boyne ROP. The Boyne IQQM model is a daily runoff and water balance model for the entire catchment including existing upstream irrigation.

The key parameters for the models are depicted diagrammatically in Figure 3 below:

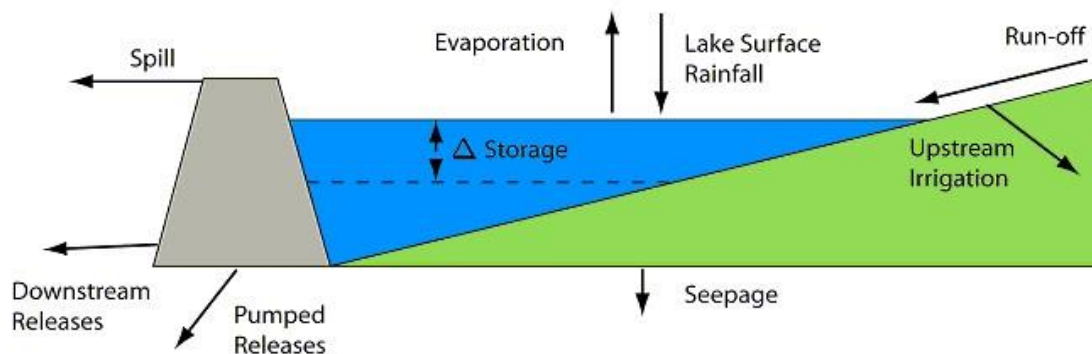


Figure 3. Model parameters

The IQQM model requires specialised software and license to be run. GAWB uses a spreadsheet model (AWSIM-D) to model water availability under drought conditions and determine Trigger Levels.

AWSIM-D is a monthly water balance simulation model for Awoonga Dam. Daily inflow and rainfall data from the IQQM models that have been summed to monthly totals are used as inputs into the AWSIM-D model used by GAWB. Daily standard pan evaporation data estimated by BoM has been summed to monthly totals, with mean monthly data been used to estimate mean monthly lake surface evaporation.

The AWSIM-D model is used in drought conditions and does not include upstream irrigation (incorporated into inflow data used), or Spills (which would mean that drought conditions do not exist).

Environmental releases are specified in the Boyne ROP. These releases are required following defined inflow events, and when the storage is above 30m AHD. These flows have been accounted for in the Model and when calculating Trigger Levels.

Releases to irrigators (farmers on the lower Boyne River below Awoonga Dam) are less than 400Mlpa and are not considered a material impact for water availability to Customers and are not included in the AWSIM-D Model.

4.4 PAST EVENTS

Inflows to Awoonga Dam have been highly variable over recent years, as has the storage volume (see Figure 1).

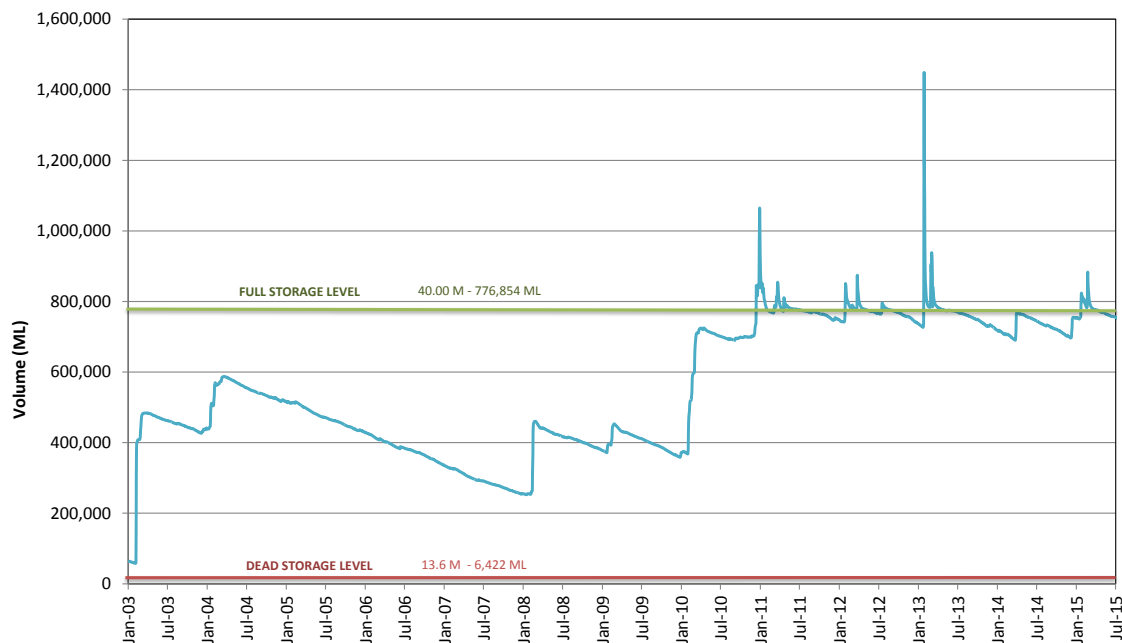


Figure 1 - Storage Volume – Awoonga Dam 2003 – 2015

Restrictions were imposed in the period 2001 – 03 and a Low Supply Alert was issued in 2007.

2007 Drought Alert

Very low inflows were experienced from late 2004 to February 2008. The lowest three year total inflow from of the historical record to date was recorded in this period, from January 2005 to December 2007, with 85,608 ML total inflow, or an average of 28,536 ML/a for three years (revised IQQM data, Oct 2014).

In October 2007, GAWB announced a Low Supply Alert as Awoonga Dam fell to 29.75 m AHD. This Low Supply Alert was lifted in early March 2008 following inflows to Lake Awoonga in February 2008. No restrictions were applied.

2001 to 2003 Restrictions

The Gladstone region suffered a very significant drought between 1996 and 2003 which saw the implementation of water restrictions in 2002 and 2003.

The water level in the Awoonga Dam fell throughout this period, reaching its lowest point of 57,800 ML (7.4% of current storage capacity) in February 2003.

Under arrangements at that time, Restrictions were set as follows:

- Stage 1 April 2002 - 35% reduction in supply to Local Authorities and 10% reduction in supply to industrial Customers; and
- Stage 2 November 2002 - 50% reduction in supply to Local Authorities and 25% reduction in supply to industrial Customers.

Rainfall following Cyclone Beni in February 2003 increased storage to 484,000 ML (approximately 62% of current storage capacity) and Restrictions were subsequently lifted on 13 February 2003.

Industrial Customers and Local Authorities were able to comply with Stage 1 Restrictions, principally through more stringent control over water use and, for local governments, the imposition of Restrictions on their domestic and light industrial customers. Compliance with Stage 2 Restrictions was considerably more difficult for all Customers. A number of industrial Customers invested in additional capital equipment (such as grey-water reuse pipelines) to reduce their water use.

4.5 WATER QUALITY

As storage levels fall, a number of water quality changes may occur. These include:

- Water temperature variations are expected to increase;
- Oxygen levels are expected to decrease;
- Nutrient levels are expected to increase and therefore the risk of algal blooms will increase;
- Salinity may progressively increase; and
- High or very high turbidity levels may be expected following initial “first flush” inflows after a lengthy period of minimal inflows.

Water quality in general is therefore expected to decline. The implications for GAWB and its Customers include:

- GAWB water treatment plants may:
 - require additional treatment chemical inputs;
 - increase water use (losses) due to increased backwashing resulting from higher influent turbidity; and
 - have reduced maximum capacity; and
- Industrial sites taking raw water may be similarly or more negatively affected.

Reduced water levels will also have a major impact on the Lake Awoonga aquatic environment. Environmental impacts will be proportionate to water level but are expected to increase significantly when water levels fall below approximately 16.0 m AHD, when average water depth reduces to below 3.0 m.

Due to the size of the remaining pool and decreasing water quality it will be necessary to increase environmental monitoring, including reviewing whether to suspend the fish stocking program until fresh inflows raise the water level.

4.6 CONTINGENCY SOURCES

4.6.1 Objectives of a contingency source and augmentation

The objectives for augmentation are to:

- Ensure that Emergency Restrictions are not required; and
- Extend supply (whilst adopting Supply Restrictions) by at least two years (and longer if possible) beyond the Timeframe from Failure.

The QCA commented on these objectives in its Final Report “Gladstone Area Water Board: Investigation of Pricing Practices, Part B” December 2008 (ch2, pp6-36). Ultimately, the QCA determined that all of the contributing and balancing factors are matters to be considered and decided by GAWB in consultation with customers in the event of a drought trigger.

4.6.2 Preferred option

GAWB has identified the lower Fitzroy River as its preferred contingency source to meet future demand and as a response to drought. The preferred option involves two projects:

1. Existing resource entitlements to be converted to water allocations, including by construction of Lower Fitzroy River Infrastructure as required (development of a new weir at Rookwood or raising the crest of an existing weir at Eden Bann)
2. Construction of the Gladstone Fitzroy Pipeline project, to deliver up to 30,000 Mlpa of water from the Fitzroy River to GAWB's existing network.

The important features of the lower Fitzroy River as a contingent source are:

- It is a different catchment to the Boyne River and Awoonga Dam, of a significant size with a more consistent baseflow, combined with significant high-flow events. Diversions from the lower Fitzroy are a relatively small proportion of these flows; and
- The flexibility of options to stage and scale the infrastructure required mean that on current parameters under a wide range of scenarios the Fitzroy source always has lower costs than seawater desalination.

GAWB has completed sufficient preparatory work on the pipeline and weirs projects to bring the project delivery timeframes within 3-4 years and to facilitate approvals and land acquisition necessary to bring certainty to the projects. GAWB has already received EIS approval for the pipeline project and expects to receive EIS approval for the weirs projects in 2015/16, which are essential for the requisite project certainty.

4.6.3 Construction timeframe

An assessment of the Gladstone to Fitzroy River pipeline indicates a construction period of two years is required.

This two-year construction timeframe assumes that preparatory work has been completed for the project, and includes some allowance for pre-construction activities (including mobilisation and revision/refinement of base plans), as well as contingency for delay. GAWB proposes that design and procurement processes will be completed prior to construction to generate firm project overrun costs, and to enable GAWB to make commitments to Customers regarding the price impacts from the augmentation.

The commencement of construction for the Lower Fitzroy storage is planned to align with the construction of the pipeline, in principle, although opportunities to defer construction will be considered subject to actual circumstances.

5 SYSTEM OPERATIONS AND MANAGEMENT STRATEGY

5.1 OBJECTIVE

The objective of the strategy is to limit Restrictions so that at least 90% of a Customer's Water Reservation is preserved (i.e. a 10% restriction) unless a Customer and GAWB agree more severe reductions via a Curtailment Agreement or adoption of a Customer's Demand Reduction Strategy.

A second objective of this strategy is to implement measures at a time that enables GAWB to respond to new information as drought conditions progress, including lower (or greater) than assumed inflows.

5.2 APPROACH

GAWB's approach is to manage to a single level of supply security based on water levels in Awoonga Dam (consistent with a single price for water ex Awoonga Dam) and provide a mechanism for individual customers to trade their Water Reservation, enabling a market-based reassignment of water between users.

Source augmentation is to be deployed to avoid the need for more severe Restrictions, and to prolong supply into the future.

This DMP applies Restrictions uniformly across the customer base until such time as emergency conditions apply. Whilst such circumstances are intended to be avoided through augmentation, this DMP gives preference to Local Authorities if an emergency does occur.

5.3 RESTRICTIONS AND OTHER MEASURES

The demand-side measures to be deployed under this DMP comprise the following:

- A Low Supply Alert;
- Imposing Supply Restrictions;
- Implementing any Curtailment Agreements to achieve savings in addition to Restrictions; and
- Inviting Customers to submit any further Demand Reduction Strategies or other alternative proposals.

5.3.1 Low Supply Alert

In the event that circumstances develop where the Model indicates **60 months Time Frame from Failure** GAWB will declare a Low Supply Alert and will provide notice to Customers:

- Informing Customers of the declaration of a Low Supply Alert;
- Providing information about augmentation, including:
 - the proposed timing for augmentation;
 - the underlying assumptions for that timing (including the inflows necessary to maintain supply and avoid Emergency Restrictions); and
 - an estimate of the impacts on water prices;
- Inviting Customers to submit:
 - proposals to reduce demand or other alternative strategies that could defer Restrictions or augmentation;
- Seeking confirmation (or adjustment) of Water Reservations within 30 days;
- Seeking voluntary adoption of additional demand management strategies/techniques; and
- Any additional matters required under contractual arrangements.

GAWB may allow Customers who do not have a Water Reservation but who have reserved water in forward sales agreements (or otherwise have made GAWB aware of their potential demands) to either:

- Enter into a firm contract to secure their identified water demand for each year;
- or

- Allow their identified water demand to lapse within a defined time period, no later than 30 days after the issue of the Low Supply Alert.

Subject to the WSSRA, GAWB will not increase the volume of water it is obligated to supply after 30 days of declaring the Low Supply Alert until such time as it has declared that the Low Supply Alert has ended.

5.3.2 Restrictions

There are two levels of possible Restrictions: Supply Restrictions and Emergency Restrictions.

Supply Restrictions

If the Model indicates **48 months or less** as the Time Frame from Failure GAWB will declare the imposition of Restrictions and will provide notice to Customers:

- Informing Customers of the decision to impose Restrictions on water supply in accordance with section 41 of the WSSRA; and
- Setting Restrictions at a 10% reduction to Customer Water Reservations.

Emergency Restrictions

If, at any time, the Model indicates **6 months or less** as the Time Frame from Failure, GAWB will declare Emergency Restrictions are in place and will provide notice to Customers:

- Informing Customers of the decision to impose Emergency Restrictions on their water supply in accordance with section 41 of the WSSRA;
- Informing all non-Local Authorities that their water supply will cease;
- Informing Local Authorities that Restrictions will be set at 50% of their Water Reservation; and
- Providing details of ongoing action that GAWB will take to monitor water levels as well as updated estimates of the timing for completion of works allowing access to additional supplies of water, including possible access to water in Dead Storage by utilisation of additional pumping and other equipment.

These Restrictions are intended to facilitate supply by Local Authorities to residents for essential uses only.

Timeframe to Failure is calculated conservatively in respect of the length of time that supply could be maintained under Emergency Restrictions, because:

- It is calculated using total demand. When supply to other demands is ceased under Emergency Restrictions, this results in a significantly longer period than 6 months in which water could be supplied to Local Authorities; and
- It is calculated using the nominal dead storage water level of 13.6m AHD at Awoonga Dam as the definition as "Supply Failure". While it is intended to implement measures to avoid Awoonga Dam reaching this level (or indeed requiring Emergency Restrictions in the first place), should this occur there is potential to access some water below the nominal dead storage level to extend supply under Emergency Restriction.

Local Authorities are also able to determine the level of restrictions which are imposed on residents and may elect to impose more stringent restrictions, which would also have the effect of reducing demand and extending the period that Awoonga Dam could supply water.

5.3.3 Demand Reduction Strategies

As set out above, GAWB will invite Customers to submit Demand Reduction Strategies or other alternatives to augmentation upon issuing a Low Supply Alert. These proposals, and other options to reduce demand, allow customers to determine their own risk appetite and to offer up demand-side solutions on a commercial basis, for evaluation alongside supply-side options. If there is sufficient benefit to all customers in adopting a Demand Reduction Strategy (by deferring augmentation and allowing more time for major inflows) then this will affect GAWB's evaluation and decisions to augment. GAWB will provide its criteria for evaluating Demand Reduction Strategies with the above Notice. These criteria are expected to be the same as, or similar to, those previously presented to the QCA.

These proposals may be a short-term abatement or a permanent measure (e.g. through investment on on-site process changes, such as conversion to dry cooling, or alternative water sources).

Demand Reduction Strategies should indicate the likely timing, extent and period of reduction, and the consideration sought and any other specific commercial terms.

The process of evaluating these initial proposals and subsequently negotiating arrangements with Customers will occur after this time. This process will be in accordance with agreed contractual arrangements with Customers. This process, as contemplated in the standard form customer contract also requires GAWB to finalise the outturn cost of the augmentation and commit to a maximum price impact. It also provides for Customers to submit a binding offer for any Demand Reduction Strategy.

GAWB will seek the QCA's endorsement of its preferred response, which may be augmentation, a Demand Reduction Strategy, an alternative proposal raised by Customers or a combination of these measures. GAWB would discuss the timing and program for any review with the QCA shortly after issuing a Low Supply Alert.

Notices, decisions and other commercial matters will occur in accordance with Customer contracts, unless otherwise agreed.

5.3.4 Ending Supply Restrictions or Low Supply Alert

Should storage levels increase such that they are above the Trigger Level from either 60, 48 or 6 months Time Frame from Failure, any decision to lift a Low Supply Alert or ease or stop Restrictions will be made only after consideration of the:

- Volume of water above the Trigger Level;
- Upper Boyne River flows, and catchment moisture conditions generally;
- Projected demand;
- Minimum projected period until re-application of Supply Restrictions and timing of these Restrictions with respect to the next wet season;
- Seasonal and climatic conditions generally, and probability of further inflow;
- impact of existing Restrictions and the benefits of easing Restrictions for (potentially) a short period;
- Attributes of the augmentation; and
- Possible changes to Trigger Level which may be required by a review of this Plan.

Any decision to ease Restrictions is subject to GAWB's overriding discretion to ensure that a reasonable level of supply will be available to protect against the reimposition of lifted Restrictions in the short term.

A decision to end any level of Restrictions or a Low Supply Alert will be the subject of immediate notice to Customers.

5.3.5 Augmentation

As set out above, GAWB aims to maintain supply to Customers at a level of restriction that is socially and economically sustainable throughout a Drought Period, avoiding the need for more severe measures. This is expressed as GAWB's criterion for triggering augmentation, which is:

to enable the appropriate augmentation to commence operations in sufficient time to avoid Emergency Restrictions and defer supply failure for a target period after allowing for inflows, losses and contracted future demand, and other forecasts as set out in the Drought Management Plan. The process to trigger augmentation involves the following:

- Establishing the objectives for augmentation, namely to:
 - ensure that Emergency Restrictions are not required; and
 - extend supply (whilst adopting Supply Restrictions) by at least two years (and longer if possible) beyond the Timeframe from Failure;
- Determining the underlying assumptions – including demand, inflows and losses (refer below);
- Selecting the appropriate augmentation response, and setting the timing of the preferred option to meet the objective after taking account of construction timeframes and project delivery risks;
- Undertaking preparatory expenditure to ensure there is the requisite certainty about the supply side response to be deployed; and
- Making a decision to construct.

5.4 TRIGGER LEVELS FOR LOW SUPPLY ALERT & SUPPLY RESTRICTIONS

5.4.1 Calculation of Trigger levels

Trigger levels are calculated using AWSIM-D monthly water balance model (Refer Section 4.3). Trigger Levels are a function of

- Assumed inflows;
- Storage losses; and
- Projected pumped demand including system losses and less augmentation supply (where and when applicable).

The assumptions to be adopted for each are set out below.

5.4.2 Inflow assumptions

The inflow assumption is a critical input for determining Trigger Levels. The selection of an inflow assumption is an exercise in risk management, and must take account of the risk of over-estimation (potentially leading to supply failure) and under-estimation (potentially leading to the unnecessarily early timing of responses). The assumption of inflows for the purpose of defining Trigger Levels does not represent a prediction, but is a credible assumption having regard to the consequences of supply failure and the need to have sufficient time to adapt to actual conditions as they unfold.

The inflow assumption used to determine a Low Supply Alert and Restrictions is currently **24,500 Mlpa**. This value has approximately a 99% chance of being exceeded over a 3 year period and a 99.5% chance of being exceeded over a 4 year period according to stochastic modelling conducted for GAWB.

This approach has been adopted with due acknowledgement of the unquantifiable effect that climate variability will have upon the use of historic inflow data.

The monthly distribution of annual flows is based on the proportion of mean monthly inflow divided by mean annual inflow.

It is important to note that this approach is based on the need to manage the risk of unforeseen events (particularly given the uncertainties of inflows) and ensure there is time for GAWB to adapt its response accordingly. In this case, the probability of such inflows occurring is an outcome of this process, rather than its determining factor.

The inflow assumption actually used to trigger restrictions and augmentation construction will be reviewed following this Low Supply Alert, in consultation with Customers, having regard to various factors including

- Latest hydrologic information, including any climate change implications;
- The time required to adapt to events that are more severe than reasonably forecast (either lower than assumed inflows or longer than planned construction period; and
- The risk of inefficiently triggering the augmentation.

5.4.3 Storage losses (evaporation, seepage & rainfall)

Losses from Lake Awoonga comprise evaporation losses from the Lake surface, and seepage into deep aquifers and through the Dam wall. Net effective loss volume is assumed as being evaporation plus seepage less direct rainfall over the Lake's actual surface area

Evaporation is based on evaporation data extracted from IQQM. Evaporation in IQQM has been estimated from actual regional Pan evaporation data adjusted to provide a lake surface evaporation estimate.

Seepage is assumed to be 300 mm per annum (which is typical for a major water storage), that is, less than 1 mm per day.

Direct rainfall is assumed to be the annual rainfall for the year at Awoonga that had actual (historic) inflow closest to the assumed annual inflow. Annual rainfall total is distributed monthly based on mean monthly to mean annual proportions.

5.4.4 Demand forecast and distribution losses (Pumped Releases)

The current demand forecasts including distribution system losses (to give total pumping from Awoonga) is set out in Figure 2 below, and includes:

1. GAWB's Base Case contracted demand forecast, which reflects demand underpinned by customer contracts, plus 1000 Mlpa allowance for losses from GAWB's treated and raw water networks. Losses on the supply to Callide Power Stations are not part of GAWB delivery system losses and are not included.
2. GAWB's forecast actual demand, based on the proportion of contracted demand that is currently delivered to customers.

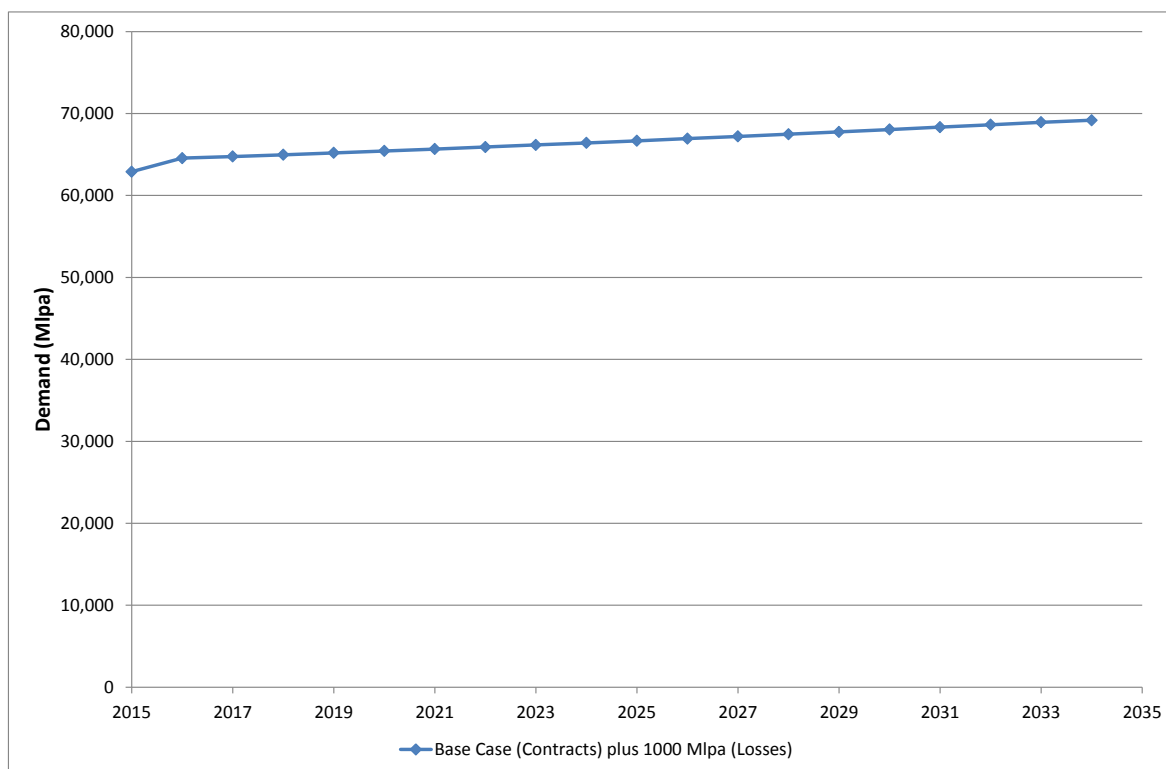


Figure 2: “Base Case” annual demand 2015 -2034

Trigger Levels nominated in Appendix A are based on “Base Case” demand including 1000Mlpa for losses.

Following Low Supply Alert, and as noted in Section 5, the demand forecast used for the determination of subsequent trigger levels will be adjusted (downwards) to the extent that customers:

- Modify their Water Reservations; and/or
 - Any Demand Reduction Strategies, which have been accepted and implemented;
- with the Supply restrictions, Augmentation and Emergency Restriction Trigger Level revised accordingly.

6 COMMUNICATION

Any Notices issued will be in writing sent to each Customer to the address listed in their contract of supply or otherwise to their registered office (as defined by the Corporations Act) or their usual postal address.

7 REVIEW OF THE DMP

The DMP is to be reviewed annually, following the end of the Wet Season (April/ May), particularly in relation to:

- Current water levels at Awoonga Dam;
- Forecast Demand, taking account of current information on base case demand and distribution system losses; and
- Any implications from (changes to) State legislation and or customer contracts.

The DMP is to have a major revision every 5 years, or at other times where there is a significant change in demand or source data, covering:

- Available water supply from Awoonga Dam and contingent/ alternative water supply ;
- Revision of trigger levels incorporating; and
 - current forecast demand, and
 - updated historic inflow, rainfall and evaporation information
- Overall application.

APPENDIX A – TRIGGER LEVELS

Item	Measure	Timing	Target demand	Storage Trigger (RL) ¹
Low Supply Alert	Information notice to Customers. Seek confirmation of demand. Seek voluntary demand reduction.	60 Months Timeframe From Failure (dead storage level)	As per Customers' Water Reservations.	33.8m
Supply Restrictions	Apply Restrictions of 10% of Customer Reservations.	48 Months Timeframe from Failure (dead storage level)	90% of Customers' Water Reservations.	31.0m
Emergency Restrictions	Local Authorities restricted to 50% of Reservation. Cease supply to other Customers.	6 Months Timeframe from Failure (dead storage level)	50% of Local Authorities' Water Reservations. Local Authorities may implement their own restrictions to achieve greater savings, thereby further prolonging supplies.	18.0m

¹ Calculated October 2015

Parameter	Value	Comment
Start date & level	1 October 2015; 39.28m	Current date and level
Assumed inflow	24,500 Mlpa	Refer Section 5.4.2
Projected demand	Varies ≥ 62,898 Mlpa from 2015	GAWB Performance Plan
Rainfall over lake surface	Rainfall 548 mm per annum	Rainfall July 1969 to June 1970, historic water year with annual inflow closest to Assumed inflow (IQQM 2014)
Evaporation from lake surface	1,460 mm per annum	Mean lake evaporation (80% x Pan evaporation, IQQM 2014)
Seepage loss	30 mm/ month	Assumed

APPENDIX B – GAWB'S DISTRIBUTION SYSTEM

